Introduction

With all the choices the satellite television dealer has to make today regarding receivers, LNA's, feedhorns, antennas etc. one might think that the choice of a mount to support the antenna is of little or no consequence to the success (both operationally and financially) and durability of an installation. And, because more and more mounts are coming packaged with the dish, many times a selection of mount is non existant--the dealer simply selects the antenna he likes (for one of any number of reasons) and takes the mount that the antenna manufacturer supplies.

We hope to show that getting involved in looking closely at mounts and taking their design into consideration when purchasing a system for resale can pay off both in the short and long term. We hope to show that all mounts are NOT created equal and that even dishes with excellent reputations can have substandard mounts supporting them. And while the immediate results of giving mount design and installation a closer look may not be as readily apparent as that of putting a hotter LNA on a system, or using a special feed, if you have ever gotten a

callback that goes : "It's good on Satcom 4 but not on Satcom 3", you have learned that in the long run they system is only as good as the mount that supports the dish.

So, we will address the whole works starting from below the ground up, including a discussion on sites, earth types, use of concrete and continue upwards to fastening the mount to the foundation, determining what goes into a good mount and end with a discussion on different types of mount design.

THE SITE

When first approaching an installation site, most dealers naturally cast their eye through the approximate location in the sky where the Clarke Orbit resides from their position. For those in the West, there is usually a little less concern than for those in the East, who usually try to verify that Satcom 3 or Galaxy can be seen low on the horizon to the West-South-West. Once it is determined that there is one (or more) locations on the site suitable for an installation, such issues as whether the customer minds looking at the dish come into play, as well as things like minimizing cable runs etc.

This is the moment when considerations affecting the mount should be addressed. One of these considerations is soil type and geography. Is it dirt? How Deep? Is the soil tight; that is very dense? Or perhaps too dense (shaley, or worse yet; plain rocks)? If it's loose, is it sandy or gravelly? If the site must be on a slope, is there proper drainage? Are there signs of erosion or slumping? If it's rock, what kind? Can it be broken apart easily or is it solid?

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after you have done a few installations and you learn which of your installations you are continually called back to because of earth considerations. Some guidelines are obvious; try to select a site that is level, protected from the prevailing winds, in deep, firm compacted earth. Avoid rock, unless there is a level spot on which to work (and remember, rock is not the end of the world as far as an installation goes). Avoid loose, shifting sandy terrain. Avoid the bases of large hills where runoff, or groundwater might cause slumping (or freezing) problems.

There are three basic types of ground mounting options in use today in the industry. The first is the installation in good firm soil, where going to the required depth is not a problem. The second involves weak or loose soil, or the situation where ledge (rock) is hit before the required depth is reached. The third is where all you have to work with is rock. The urban equivalent would be an existing cement slab. Let's take them one at a time and look at some of the considerations that affect the success of the installation.

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THE 'DEEP PLUG' POST MOUNT

Where there is plenty of good firm soil, as in many parts of the country, most installers simply auger, back hoe, or manually dig a big hole and place a pipe (in most cases 3" to 6" schedule 40 pipe) into the hole, and fill it with cement. Occassionally sono tubes or other forms are used, although the former are expensive and only really necessary if the integrity of the earth around the cement is not good. Other types of forms such as a 55 gallon barrel with the ends cut off work equally well.

There are two major considerations here : how deep a hole and how much cement? There are probably as many answers as there are dealers in the country. To gain a foothold in properly assessing the answers. one must consider the size, weight and construction of the dish, the vulnerability of the site to wind and frost and last but not least, the relative benefits of 99.9% security that a callback will not happen (due to mount movement) versus the cost of digging the hole, mixing and placing the cement (not to mention the cost of the cement itself).

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dish and mount will disintegrate before the overturning moments will affect the foundations. The same cannot be said about frost, as even enormous quantities of improperly placed cement can be moved by this silent force. Discussions in a moment for those that need to deal with frost.

The thing that determines whether frost applied to the dish or mount will move the assembly is best explained by a little physics lesson. First some terms: A 'moment' is defined as a force acting on an object through a lever arm. The lever arm is the element that carries the action of the force to the resistance to that force. Refer to drawing 1 for some simple examples of this as applied to mounts. Wind (or the next door neighbour's 67 plymouth station wagon) is the force acting on the dish, the mount, and the post supporting it. The lever arm is the post itself, and the resistance to the force is the earth pushing back the side of the 'plug' of cement which holds the post. There are actually two forces acting in this fashion (those engineers reading this will take exception to this gross simplification: there is a continuous field of forces at every point of contact between the cement plug and the earth).

Without getting carried away with the theory of why a dish may or may not come down in a wind, we can deduce the following guidlines in determining how deep the hole and how much concrete:

1. The bigger the dish, the deeper the hole and more concrete.

2. The heavier the dish, ditto

3. The taller the post, ditto

4. The more remote or difficult to access or maintain, ditto

This last item may strike some as being a little curious. To explain, the tradeoff mentioned above that the consequences of movement of the mount versus the cost of assuring that it will never happen. Experience is the best teacher, but as a rule of thumb, if prevailing winds are of average strength and the possibility of storms, tornadoes etc. is minimal, one would unlikely be called back to an installation (for mount movement) by using a minimum of 1/2 yard of cement for a 6' dish, 1 yard for a 9' to 11' dish and 1.5 to 2 yards for a 12' to 16' dish. Using the rules above, mesh dishes would require less cement than their fiberglass size equivalents (not because they allow

more wind to pass through them as some believe), because they have less mass, which is a factor in oscillation (discussed below). Well protected sites can get away with less concrete than exposed windy locations. High traffic areas (near a parking lot, for example) need more; (yes, it is possible that a vehicle might hit the dish).

This business of assuring that the post never ever moves out of plumb is one that can be addressed by simply designing the means to adjust the plumbness into the mount. Several mount manufacturers including ourselves have recognized this as being an enormous aid to the dealer who does for one reason or another have to go back to a site to readjust the mount. If the pipe were placed directly in the cement, the consequences of movement would not be good; it would be difficult to make the mount rack properly, unless the pipe is bent or removed and replaced.

Below we describe a simple way to avoid having to make absolutely sure nothing moves once the post is set in the concrete, but let's discuss the second type of installation that involves loose or sandy soil.

THE PAD MOUNT

The second general type of mount installation involves soil that is either too loose to excavate deep succesfully, or is too shallow over bedrock. A third reason for using this type of installation is the case of swampy or spongy earth.

Referring to drawing 2, we see that resistance to the forces applied on the dish may be resisted by maintaining the same mass of concrete as in the deep plug method, but redistributing it outward from the post. In the case of a tripod assisted mount (similar to the ones Channelmaster produces) or the integral "tripod" mount under the ADM series of antennas, this type of pad may prove the simplest to install regardless of soil condition.

The depth should be maximized as is reasonably practical, and the size of the pad should be such that perhaps 25% more conrete is used per given size and construction of Dish as noted above. This is because we are relying solely on mass (and therefore gravity) of the pad to resist the overturning moment applied by wind acting on the dish and mount.

In the case where bedrock is struck within 12" of the surface,

it is advisable to increase this mass by building forms above the ground plane to form a pedestal effect. A slab much thinner than that becomes more difficult to pour properly without reinforcement and the installation risks fracturing of the pad itself during severe stress on the mount and dish.

It should be noted carefully that this type of installation, if used in the Northeast, or other areas where frost is a problem, rarely puts the base of the concrete pad below the frost line and so should be avoided unless the technique described below to mount the post to the cement is used, greatly simplifying the correction of a tracking problem due to shifting of the foundation.

MOUNTING ON ROCK

The technique for mounting a post to solid rock is very much the same as the technique suggested for mounting to concrete (which may as well be rock once it is set). The first consideration should be really to avoid it all together if possible, as it can be tricky. If there are no nearby alternatives, the installer must determine the structural integrity of the rock itself. Examples of rock types that are at

the top of the list would include granite and gneiss, most other igneous rocks; limestone and sandstone are not that bad if they are tight; that is, they don't come apart easily. The installer can usually tell by simply finding an outcrop of the rock and beat on it with a sledge hammer; If the outcropping breaks off easily and fractures into small pieces, the installation may not be advised.

Once the installer determines that the rock is structurally sound, a flat section is located where four anchor studs may be placed. Generally, in very strong rock such as granite, studs 5 or 6 inches long may be sufficient. The softer the rock, the deeper one should attempt to penetrate.

Now, how to penetrate it. While a masonry (carbide) bit on a standard 3/8 or 1/2" drill may do the job, it will take forever (let's see, at $12.50 an hour, that would be....phew!). The simplest and quickest way to do this is with a rotary hammer drill such as a Hilti TE-17. This machine looks like a drill, acts like a drill but can put a 3/4" hole 6" deep in granite in less than 10 minutes! It's a handy tool to have for other types of installations such as fastening tripod legs etc. or placing

anchor studs in concrete as used below. As always, one must trade off the convenience with the $150.00 - $200.00 price tag. Once the holes are drilled, anchor studs are driven into the holes and a nut with spacers is tightened down on the stud to flare the piece on the lower end of the stud. We prefere tee single piece studs to the split lead thread type only because we believe they are stronger. After the studs are in place, it is a good idea to seal the top of the holes with either a very wet mixture of cement or regular roofing cement, keeping water from seeping down into the holes. (Not neccessary where freezing does not occur). The flange described in the next paragraph is then typically used for installations on rock.

In all of the installations described so far there is one common objective; to assure that the post holding the mount is vertical and that it stays that way. One way to greatly reduce these consequences is to weld the pipe to a flange and attach the flange to anchor bolts or studs in the cemnent. This is common practice for virtually every lamppost, sign and many structures. For most dishes being manufactured today a 1/2" thick flange between 10" and 14" in diameter should be

suitable. Many of the special mounts we manuacture use this technique. Unfortunately there is a trend in mount design today to stop at the top of the post, and let the dealer pick up the pipe locally. (There never was a lot of profit shipping pipe around the country). Roundhouse Manufacturing (White River Junction, VT) has developed a hybrid solution to this problem, which is shown in figure 3. It consists of a flange welded to a piece of pipe that receives the post and holds it firmly with large setbolts. The shipping weight of this is reduced, it can be UPS shipped inexpensively.

The major feature of attaching the mount, one way or another to the concrete via a flange rather than directly into the concrete is that the concrete can be placed rather haphazardly, or if a contractor is doing it he can use much less care in the way the cement is placed without having to assure absolutely that the post is vertical. If standard graded achor bolts are used, the only great care required is that they are placed so they match the holes or slots in the flange itself. If anchor studs are used with the Hilti gun as described above, there are very few precautions needed at the time of pouring the

concrete, a possible cost saving as less experienced labor may be used to place the concrete.

ASPECTS OF MOUNT CONSTRUCTION

Now that we have finally got a post sticking out of the ground at our site, what do we put on it? Any trade show veteran will know that the array of steel and aluminum is impressive. Many dealers might avoid the question of what makes a good mount all together and simply select a dish and mount combinations based on other seemingly more improtant factors such as dish quality, availability, distributor recommendation or price.

Without getting tangled up in questions that have to do with dish performance let's look at how one might decide which dish-mount system to purchase on factors involving the mount. We will look at everything from overall design and construction factors, to details of finish, hardware, integrity and quality of welds etc.

The first and foremost thing to appraise is whether the mount was designed to be an integral part of a system or simply used because it was available. If the dealer is purchasing dishes

from one supplier and mounts from another, the burden rests on his own shoulders to make sure that the two are suited. If both are purchased from one source, one can not be absolutely sure that the two are suited, if the distributor is making the decision (which might be based on many other factors beside engineering). There are many single piece fiberglass and spun metal dishes in use today and by reason of their design can usually accomodate many types of polar mounts.

In this case, one should attempt to appraise the stiffness of the mount in combination with that dish. This can only be done properly when installed, ideally with pictures on the screen. There is a very sophisticated technique known to a few of us in the industry that will determine the overall stiffness of the mount, which, in our opinion is one of the single most important features (requirements) of any mount. This sophisticated technique is called "shake the dish". We describe it in detail below.

Unfortunately, at trade shows, where most of the "tire kicking" goes on, the technique does not work as well, because most of the mounts are only held down with sandbags or similar heavy

items. You can still get a fair idea though. Here it is. With the dish aimed very nearly south; that is at the highest azimuth it is likely to be at (varies with location around the country), go to a point at the southernmost (lower most) edge of the dish. In most cases this will be at waist or chest level. Using 4 fingers on either the front or rear of the dish, begin to pull on the edge of the dish and then release before too much force is exerted. Attempt to apply pressure in resonance with the natural frequency of oscillation of movement of the dish. The same technique might be used to start a child (or one's self) swinging on a swing. Increase the pressure until you get a good rythm going. Don't pull the dish over.

While this motion is happening, look first at the ground, where the post is fastened. If it is a secure mounting (such as into a concrete plug), there will probably will not be any motion there. Then follow the post up to where the main elevation joint is and observe any slop or motion in that joint. Also observe any turnbuckles or adjustors in the elevation linkage of slop or motion. Look at the dish itself and see if the dish is changing its shape either as a result of a point force acting

[illegible]

[illegible]

[illegible]

[illegible]

upon it (your hand) or because the resulting motion is causing the bolt up points between the dish and the mount to warp the dish.

If there are pictures on a screen nearby, you might just observe them to see if there is enough motion to lose them. If there is you already have some problems, although they might be related to some things besides the mount.

While you're here let the dish settle back down and grasp the dish perimeter with thumb and forefinger and apply a gentle, rythmic motion in a direction tangent to the dish. This direction would be the same as that of a record on a turntable. (Imagine the dish to be a long play album). As before, gently increase the force and try to match the natural frequency. And as before inspect the entire mount for looseness or flex. Compare it to the first test and note the precise locations where motion or flex is detected.

Next, rotate the dish on it's polar axis to a low satellite (Galaxy from the east coast for example). Move around the perimeter of the dish until you are at a point on the edge that is 90 degrees around from where you were before. That's about a

quarter the way around, one panel in a 4 panel dish or 2 panels in an 8 panel dish for non-matheticians amongst us.

At this location perform the same test as above and note motion about the polar axis. This is where jack slop will be noted if it exists. Observe carefully and mentally subtract it from mount motion to determine how stiff the mount is itself. Often many things can be done to minimize jack slop.

The point of all this "flex and watch" activity is to determine if, given all the realities of the dish/mount system, it does not have much built in motion. The obvious conclusion can be drawn from this exercise. In general, a dish and mount designed to go with each other from the start have the best chance of providing a stiff system.

Some dishes, mesh dishes in particular even use the mount for assistance in maintaining the shape of the dish itself. The ECI dish is an example of this construction, and it makes for not only a stiff mounting system but integrity of the shape of the dish also.

Among the more important details to look at in mount construction are the welds. A good weld is stronger than the

two pieces of steel joined by it, but invariably, mount failures usually happen at a weldment. Figure 4 shows an example of what good and bad welds look like. In many cases there is no way to know by looking at a weld if it has proper penetration, which is how deep the metal pieces to be joined are fused together. General appearance for uniformity and flatness of welds can go a long way, however in assuming that the manufacturer had proper QC procedures to assure consistently good welds.

Other details to look at include hardware. Most good quality mounts now include all the hardware the dealer needs to do the installation. Most of the better products on the market include either zinc plated or stainless steel hardware. While stainless steel is stronger than normal hardware, strength is not usually a factor in most uses of hardware in polar mounts today. It's corrosion resistance is somewhat better than zinc plating particularly when used in conjunction with aluminum.

A note of caution is in order here regarding the use of dis-similar metals in mount-dish systems. In most cases, it will not pose a corrosion problem, but in very humid conditions

or installations near the sea coast, problems can occur when steel is bolted directly to aluminum. If the system is all not properly grounded and leakage across terminals in actuator housings etc. occurs, severe corrosion can happen as a result of these dis-similar metals being in contact with each other. This phenomenon is well known to yachtsmen and every mount manufacturer should have background in this area (or at least a retired yachtsman on their design team).

Finish is the last item we will discuss about the overall construction of mounts. The ideal finish for any polar mounts, from a durability point of view, is a galvanized finish. Next to that, a zinc plated finish provides the same corrosion resistance (but the zinc is laid down in a thinner coat than with galvanizing; which is zinc as well). The disadvantage of standard galvanized or zinc plated finishes is that the color (silver) may not be desirable. Black zinc finishes are sometimes available but more expensive and an array of galvanized finishes are available to some mount manufacturers, but their cost is very prohibitive.

Paint coatings come next, and of all, the powder coatings and

baked enamel finishes are the most durable, but as with all painted finishes, the surface must be prepared perfectly. A scratch in a powder coated paint finish renders it no better than regular paint, if the bonding between the paint and steel is not uniformly good.

The finish on the mount is usually selected on the basis of what looks good rather than what will last and that's OK as long as the mount is properly designed with the right amounts of steel in the right places. In all but seacoast areas, a totally exposed, properly sized and designed mount might last a great deal longer than many other parts of the system. It might look like a rust bucket but will be structurally sound.

ROOF MOUNTS

As with installation on rock, installations on roofs are to be avoided if possible. Unfortunately, this avoidance can lead to lost sales now that smaller dishes are working better and better. The natural place for these dishes is the roof.

By far, the most convenient roof to work on is a flat one and many tripod type of supports used on the ground can be used on

this type of roof. If the roof is on a commercial or city dwelling building, the roof is likely made of concrete or heavy wooden rafter construction, the former being one of the best materials to mount a dish on. Care must be taken of course in sealing any penetrations in the roof surface, as water which penetrates this barrier will travel laterally and possibly do damage to whatever is below.

The residential pitched roof is somewhat more difficult to work on, unless you are a mountain goat. The most widely used mount for these types of roof is the A-Frame tripod, shown in photo #?. This mount has two legs that mount at right angles to the roof pitch and a third leg going up the roof. If properly manufactured, it's design provides one of the stiffest foundations possible for the post and dish that go on it. They are also fairly easy to install.

Another type of roof mount is the four legged peak roof mount. Although usually significantly more expensive than other types, and more difficult to install, they can provide a good support for dishes.

An important thing to realise about roof mounts is that the

installation is only as good as the roof it is on. This means careful inspection of the roof structure, and that means getting inside the attic or ceiling to make sure that there is sufficiently strong structure to carry the loads.

ELEMENTS OF MOUNT DESIGN

Many mounts today are not really designed at all but either simply thrown together to provide the necessary axes of motion in a polar tracking mount, or copied from someone else's 'thrown together mess'. You don't have to go to too many trade shows to realize that there is still at this point not enough product available for everyone. This will change soon for two reasons. First, the supply will catch up and surpass the demand, allowing the dealer to be more selective. Second, as failures in mount start to occur (one, two or three years after installation), and as 2 degree spacing becomes more prevalent, a new standard will emerge for mount designs that work well, provide the required stiffness at minimum weight and cost, and that are easy to install and maintain.

While there is no simple way to describe all the elements of

good design in a mount, experience is usually over time, to be relied on in selecting anything purchased for resale, mounts included. The best thing to do is find a good one and stick with it. A dealer can improve his chances of finding a good one by avoiding anything that looks like it was built in a garage, because it probably was. Look for stiffness using the technique we have described; and when at trade shows, don't avoid talking to the people who manufacture a product you have used and ways to improve it or make it simpler to install. We at Roundhouse Manufacturing have produced some of our best products in response to such an expressed need of our customers.

Finally, a note on installation procedures. We find that it is a good idea to keep a logbook to be used during installation, to record certain dimensions or procedures associated with mount installations. Declination angle, for instance might be measured in linear distance between marks on the mount, the jack tube might be similarly calibrated etc., so that if one is ever called back to the site, one might know instantly if the problem is mount related. Using care in selecting and

installing the polar mount, however should minimize callbacks for that reason.

BASIC MOUNT DESIGNS/THE DIFFERENCES

Then there are the questions of which type of mount to use for a particular installation, In the boom of home TVRO dishes, most everyone assumes now that there is only one type of mount; the common polar mount with which we are all familiar. With the number of satellites increasing and being spread out more in the geosynchronous orbit, and with the advent of C-band DBS systems popping up in dealers' showrooms, it might be a good time to take a look at the entire spectrum of mounts, including polar, az-el, X-Y, fixed as well as several different actuation methods including horizon to horizon, linear actuators, etc.

Let's start with the old days, when commercial installations were the only type around. More often than not, they were fixed; that is, other than small motions available for fine tuning, when they were installed, they did not move again (unless taken down by a hurricane). The advantages of a fixed

mount are obvious: no drive system to purchase or maintain, less installation time, less down time, usually very stable. One of the most common fixed mount arrangements is the trapezoidal az-el type seen outside of radio and television stations to pick up network feeds. They always point at one satellite and even though the basic motion allowed during set-up is az-el, we don't classify them as such if they are fixed upon installation.

These mounts are very stiff for their weight, and because they are usually nothing more than a number of tubes or structural shapes, they can be shipped easily and knocked down. The disadvantages include primarily not being able to track the geosynchronous orbit and a rather large pad required to mount them; usually at least the diameter of the dish.

Virtually any other type of mount design can be made a fixed mount by removing the actuator or motor-drive, but this is wasteful and costly use of material if a fixed mount is desired. Az-el mounts are the most common types to be used in this fashion, because they are the simplest to point during installation.

The simplest type consists of a pipe in the ground over which another pipe is placed. This pipe supports an axle which then allows elevation movement. This is sometimes called an EL over AZ mount because the elevation axis is placed on top of the aximuth axis. Many of the C-band direct 6 foot dishes on the market today have such an arrangement. These dishes are then fixed once aimed at Galaxy 1.

The same arrangement is used for many large (10 meters and up) commercial installations but each axis is driven by large or hydraulic actuators. To move from one satellite to another both actuators are moved usually preprogrammed by computer controls. The advantage of this type of mount is that it is easy to aim precisely at any satellite in the arc with great precision. Large aperture reflectors with narrow bandwidth need this precision if every last fraction of a decibel is to be gained from the system. Another advantage is that this type of mount is simpler than a polar mount. At Roundhouse Manufacturing, the Az-el mounts we have designed and manufacture are on average 20% lighter and less expensive than a polar mount for the same size dish. The place to use an az-el

mount is where great precision in aiming is required or on the other hand, where an occassionally moved fixed mount is required.

Another type of mount which is 'two axis' is the X-Y mount. This is similar to the elevation mount except the two axes are reversed in terms of which supports the other. That is, instead of elevation axis being supported by the azimuth axis, in an X-Y mount the azimuth axis is supported by the elevation axis. Technical readers will observe that a polar mount is a unique type of X-Y mount, with elevation set for a particular location and fixed.

X-Y mounts are rarely seen today. Roundhouse manufacturing makes specialized X-Y mounts designed to track Molniya satellite. These mounts incorporated into Orbita Systems'(New York) complete reception system, allows for precise tracking of the very peculiar track that Molniya takes across the sky when observed from the ground. Other than this use, the satellite TV dealer is not likely to have a need for this type of mount.

Polar mounts are by far the most commonly used today in our

industry. Their primary advantage is the reason that they require only one axis of motion to very nearly track the geosynchrous orbit. We say very nearly because any polar mount will not track the orbit perfectly unless it is on the equator. There is a small error (about 1/2 a degree) between the satellites due south of the observer and those very near the horizon. There are ways to incorporate correcting motion in the design of a polar mount and Roundhouse Manufacturing has designed such a mount, but the cost is not justified, because beamwidth of most reflectors under 16 feet is greater than the 1/2 degree to being with.

It must also be udnerstood that the most common way of peaking a dish (alternating between adjusting elevation at a high satellite and azimuth at a low satellite) compensates for this error and when done properly puts the maximum error at about half of the 1/2 degree or about a 1/4 degree. It is a little known fact that polar mounts will track better if the elevation is set for a higher latitude than that of the sight, and the declination set for a little less than the proper declination for the latitude to compensate., Other than the initial setting

for the declination, most installers accomplish this using the peaking system mentioned above without even knowing it. The real secret is knowing how much to under shoot the declination. This whole discussion might be splitting hairs considering that most dishes around 8 to 10 feet can't even be aimed closer than a degree and a half. But there is always the challenge to get the most out of any system.

Having discussed the four major types of mounts, we turn our attention to methods of moving dishes. Far and away the most popular today is the linear actuator. Originally used in hospital beds, these actuators which are really just a threaded rod inside a tube which extends when the rod is turned, do the job well although many installers have learned (the hard way) that you can't just take something out of one application and put it in another without problems. Freezing is one of the major probles with these units; especially those not manufactured with rubber boots and drain holes to allow moisture to escape. Newer units have been designed specifically for the satellite industry and have fewer problems.

The chief advantage of linear actuators is that they are

common and fairly inexpensive. Additionally, they are fairly easy to mount and aside from the freezing problems some have experienced, work pretty well. Their chief disadvantage is that their motion is limited and the forces exerted on the movable part of the mount tend to change as the dish goes from the horizon on one side of the mount to approximately south (to the highest satellite).

This can be disasterous if the mount is poorly designed and does not position the clamp and upper end support in the right places. Stories abound about wrapping jacks around mounts, bending the tubes. Granted, most linear actuators have internal limits designed to prevent this but in some mounts so little motion is allowed (or sideloads are placed on the jack) that it is difficult for the installer to get all the desired satellites without risking damage to the actuator.

This factor, as well as the fact that the geosynchrous orbit is getting filled up and is spreading out, has created much interest in horizon to horizon motion systems. These are identified primarily by the large D shaped ring that carries a chain which acts as the transmitter of energy to the mount.

Other systems available today include a worm and wheel arrangement but the chain drive type seems to be more prevalent.

The chief advantage of this type of drive system can be found in it's name: Horizon to Horizon coverage of the satellite belt. These mounts are really polar mounts with 180 degrees of azimuth coverage. This is essential if the customer would like to look at satellite programming available from satellites over the atlantic as well as the domestic satellites. The primary disadvantage right now is the cost; a good, well engineered system costs considerably more than a linear actuator and probably worst of all most horizon to horizon systems are not an option; they are either designed into the mount or they are not.

PO BOX 48
SAN ANDREAS, CA 95249

JANUARY 24, 1981

Dear Bob,

Just talked with Rick and told him the editing is all done. We certainly have different styles but I have resisted the terrible urge to re engineer - I mean re write - and consider the final product the best possible combination of our two talents.

Per our discussion I would like to see the final "thing" before it goes to a printer and the equivalent of a galley before the presses roll. I will be quick with it and think that it will be the best way to eliminate some of the questions that people are still asking about old number one. This is not a criticism of your abilities, it is simply a fault of mine that I am not able to function until I have the whole thing in front of my eyes. I do know people who can write an article leaving blanks for the experimental results but not this kid!!!

We need a wrap up at the end - I suggest the following as part or all of it:

Now that you have pictures on a system of your own what are the improvements other than better Amplifiers, bigger antennas etc which can be made to increase performance. The following areas should be considered:
1. The feed horn design presented is simple but performance can be improved a half to one dB by going to a scalar feed such as the Chaparral super feed available from Chaparral Communications, PO Box 832, Los Altos, CA 94022 for $135 in singles.
2. The receiver design has been kept to the simplest possible and therefore has no selectivity ahead of the first mixer. As a consequence noise or interference at the image frequency range (2 to 2.5 gHz) can be folded on top of the TV signal and cause a degradation in performance. Certain LNA designs produce noise at the image frequency range and badly damage picture quality. Also certain radars operate in that band and can cause problems. These can all be cured by the addition of a bandpass filter, amplifier such as the ICM Purefier available from International Crystal Mfg, 10 N Lee Street, Oklahoma City OK 73102 or from numerous TVRO dealers.
3. The 564 PLL is the limiting factor in video quality in the present receiver due to its limited tracking range. It has been the only game in town until recently, however, and has been widely used by amateurs and manufacturers alike. There is now an alternative made by Microelectronics Technology Corp of Palo Alto CA. It is a divide by two detector packaged in a 20 pin single-in-line IC form which can be substituted for the 564 with superior results. While it does not plug into the Howard Coleman board it can be put on that board with an hours work. It is also likely that adapter boards will be available soon. The detectors are available from Robert Coleman and from International Crystal.
4. The clamp circuit is very simple - simple enough that some higher quality VCR s have trouble recording the video the receiver puts out. The next step in clamps technologically has been nearly as complex as the whole receiver until now. A new video processor has just been announced by the company making the detector above and will be available from R. Coleman as soon as production commences. CSD is a good source for information and Ads about such new products.

Finally; the author will be anxious to hear from you regarding your experiences and improvements (and mistakes in the manual). Builders of the first version of the terminal have been most helpful and the positive comments received have inspired the author to keep the system up to date and to publish this new manual.

That should do it and you can add what you like. In the meantime keep busy - I don't want you sitting on yours while mine is moving at the speed of light. Keep busy - who's kidding whom.

Best regards to all of you,

Tay

H. T. Howard

and remember, no problem in Spanish is, "no problemo" - what a great line. t